plate to seal the first vial, while moving one of the second vials underneath the first opening to receive a next water sample over a next preset time interval. The carousel rotates after each of the second vials has been filled at the end of each successive preset time interval until all of the vials have received a separate water sample. Each vial is sealed after being filled.

According to another embodiment of the present invention, there is provided a method of collecting multiple water samples over multiple preset time intervals, including providing a first reservoir, a second reservoir, a carousel with multiple vials including a first vial and multiple second vials, and a sealing plate resting on a top of the carousel; capturing water in the first reservoir over a preset time interval, the water being homogenized during the preset time interval; transferring a predetermined amount of a water sample from the water in the first reservoir to the second reservoir at the end of the preset time interval, and discharging any excess water from the first reservoir; locating the first vial at a first filling position on the carousel; providing a first opening on the sealing plate corresponding to the first filling position; rotating the carousel after the first vial receives the water sample from the second reservoir to position one of the second vials at the first filling position to receive a next water sample over a next preset time interval, the first vial being rotated away from the first filling position and underneath the sealing plate as the carousel rotates to seal the first vial; and rotating the carousel after each of the second vials has been filled at the end of each successive preset time interval until all of the vials have received a separate water sample, each vial being sealed after being filled.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other aspects and advantages of the present invention will become apparent and more readily appreciated from the following description, appended claims, and accompanying drawings, of which:

FIG. **1** illustrates a sequential, time-integrated fluid collector according to an embodiment of the present invention;

FIG. **2** illustrates the layout of sample vials on a multi-sample carousel for the collector of FIG. **1**;

FIG. **3** illustrates a sealing plate with a low-friction surface resting on top of the carousel of FIG. **2**;

FIG. **4** illustrates a sample delivery system for the multi-sample carousel of FIG. **2**;

FIG. **5** is a side view of the multi-sample carousel of FIG. **2** showing the sample vials sitting on foam rubber, and components of the sealing plate of FIG. **3** used to seal the sample vials; and

FIG. **6** illustrates a screen for a first reservoir and a shield for a second reservoir for the collector of FIG. **1**.

DESCRIPTION

The present invention provides a collector with an electronic controller that receives a start signal from, for example, a manual push button or switch, a timer, a cell phone, or a rain sensor that initiates operation of the collector when it gets wet. Once started, the controller actuates either of two electrically-actuated valves, each connected to a water reservoir. At preset intervals, determined by, for example, a synchronous motor with adjustable gears in the controller or an electronic timing circuit, water samples are transferred into plastic or glass sample vials in a multi-sample carousel. Evaporation that could change the isotopic composition of a precipitation sample is minimized by sealing the opening of each sample vial by pressing each vial against a flat, low-friction surface, such as a Teflon® sheet, from the time each sample vial is filled until it is removed from the collector.

The operation of a collector **10** according to the present invention can be understood by referring to FIG. **1**. Generally, FIG. **1** shows a first reservoir that captures and homogenizes each water sample collected over a preset time interval. The reservoir includes a first funnel **12** and a first valve **14**.

A second reservoir extracts a preset maximum amount of water from the total amount of water in the first funnel **12**. The second reservoir includes a second funnel **16** and a second valve **18**.

A transfer line **20** feeds the water sample by gravity flow from the second funnel **16** to a multi-sample carousel **22**. The transfer line **20** may be constructed of flexible plastic, for example.

The carousel **22** holds multiple samples in multiple sample vials **24**. After each sample is collected, it is sealed by a sealing plate **26** having a low-friction lower surface to prevent evaporation of the sample and eliminate the accompanying fractionation of oxygen and hydrogen isotopes in water that would otherwise occur.

An electronic controller **28**, whose operation can be initiated from a variety of inputs, controls operation of the first valve **14**, the second valve **18**, and the carousel **22**.

The operation of the collector **10** is now described in greater detail.

A start collection program of the controller **28** is initiated from a variety of inputs, such as a cell phone **30**, a precipitation detector **32**, a timer **34**, or a manual push button or switch **36** on the controller **28**. Once the controller **28** has started, precipitation samples are loaded into the sample vials **24** at equal time intervals. The sample vials **24** may be constructed of glass or plastic, for example. Only two such vials **24** are shown in FIG. **1** for ease of illustration. The time intervals may be preset by changing gears on a synchronous motor (not shown) that drives cam switches (not shown) in the controller **28**. Alternatively, the collector **10** can be controlled using integrated circuit timing.

During a preset time interval (commonly 30 minutes), water is collected and homogenized in the first funnel **12**. The first funnel **12** may be constructed of materials such as plastic or aluminum, which can be anodized. If the first funnel **12** is constructed of aluminum, it can be fitted with a thermostat and heater (not shown) to melt snow or hail. The first funnel **12** may have a diameter of about 20 cm, with a maximum sample volume of about 1000 mL, for example. The size of the first funnel **12** is selected to have a volume sufficient to prevent overflow during collection of a water sample during the preset time interval so that none of the sample, which is composited over the preset interval, is lost.

The first funnel **12** is connected to the first valve **14**, which is normally closed. After the preset interval, the controller **28** operates a first actuator **42** to open the first valve **14** for sufficient time (about 1 minute) to allow the water to flow directly into the second funnel **16**, which holds the water sample that will be transferred to one of the sample vials **24**. The amount of time the first valve **14** is open is adjustable. The volume of the second funnel **16** is typically selected to be about 75% of the volume of the sample vials **24** that hold each sample. A size of about 15 mL works well for the second funnel **16**. If the amount of water in the first funnel **12** is less than the amount that the second funnel **16** can hold, all of the sample water is captured and transferred to one of the sample vials **24**. If the amount of water in the first funnel **12** is greater than the maximum amount of water the second funnel **16** can hold, the excess water spills over the sides of the second